ANGLER HARVEST SURVEY

FRANCES LAKE 2009

Prepared by:

Nathan Millar, Oliver Barker, and Lars Jessup

Yukon
Environment

April 2012

ANGLER HARVEST SURVEY
FRANCES LAKE 2009
Yukon Fish and Wildlife Branch
TR-12-06

Acknowledgements

Greg Lutz conducted the field work and Rory Masters compiled the report, both under contract to Yukon Department of Environment. Jean Carey and Rob Florkiewicz reviewed the report.

© 2012 Yukon Department of Environment

Copies available from:

Yukon Department of Environment
Fish and Wildlife Branch, V-5A
Box 2703, Whitehorse, Yukon Y1A 2C6
Phone (867) 667-5721, Fax (867) 393-6263
E-mail: environmentyukon@gov.yk.ca

Also available online at www.env.gov.yk.ca

Suggested citation:

MILLAR, N., O. BARKER, AND L. JESSUP. 2012. Angler Harvest Survey: Frances Lake 2009 Yukon Fish and Wildlife Branch Report TR-12-06 Whitehorse, Yukon, Canada.

Key Findings

- Anglers spent 1,592 hours angling on Frances Lake in the summer of 2009. This was 0.16 hours angling/ha over the summer, a low level even for a large Yukon lake.
- Angler success, as measured by the number of lake trout caught per hour of angling, was above average compared to other Yukon fisheries surveyed to date and up from previous surveys.
- Anglers caught 499 lake trout but released 78%. Including a 15% rate of incidental mortality (death) from catch and release, the total estimated harvest was 315 kg of lake trout. This is less than the estimated Optimal Sustainable Yield of about 600 kg, but there are several sources of unquantified harvest: the ice fishery, the open water fishery outside of the survey period, and First Nation subsistence harvests. There is a small harvest of fish by guests at a wilderness lodge on the lake. So long as these harvests are less than about 285 kg, then the lake trout harvest is sustainable and should maintain a quality fishery.
- Most anglers fished for lake trout; the catch and harvest of both northern pike and Arctic grayling were down from previous surveys. Burbot and bull trout were caught only occasionally.

Table of Contents

Acknowledgements ..... Inside Cover
Key Findings i
Table of Contents ii
List of Tables iii
List of Figures iii
Introduction 1
Harvest Regulations 2
Methods 2
  Survey 2
  Analysis 3
  Lake Productivity 3
  2009 Frances Lake Survey 4
Results of the 2009 Survey 5
  Effort 5
  Fishing Methods 5
  Methods of Access 5
  Guided Anglers 6
  Angler Origin 6
  Visitor Type 6
  Weather 6
  Targeted Species 7
  Catch and Harvest 7
  Biological Data 8
Comparison With Previous Surveys 10
  Effort 10
  Fishing Methods 10
  Methods of Access 11
  Guided Anglers 11
  Angler Origin 11
  Visitor Type 12
  Weather 12
  Catch and Harvest 12
Fishery Sustainability 14
References 16
APPENDIX 1. Frances Lake angling regulation changes 1989 to 2009.. 17
APPENDIX 2. 2009 Results: Comparisons between periods 18
  Effort 18
  Visitor Type 18
  Catch 18
APPENDIX 3. Productivity of Frances Lake relative to other Yukon Lakes. 20

List of Tables

Table 1. Fishing Methods..... 5
Table 2. Angler Access Methods..... 6
Table 3. Angler Origin..... 6
Table 4. Sample Day Weather..... 7
Table 5. Catch and Harvest by Anglers Targeting Specific Species..... 7
Table 6. Angler Catch and Harvest..... 7
Table 7. Estimated Catch per Unit of Effort (Fish/Hour). 8
Table 8. Sampled Lake Trout Stomach Contents..... 10
Table 9. Total Estimated Angler Hours..... 10
Table 10. Fishing Methods (Percent of Parties)..... 11
Table 11. Origin of Anglers (Percent of Parties)..... 11
Table 12. Weather Effects on Angling Activity (Percent of Parties)..... 12
Table 13. Estimated Number of Fish Caught, Fish Kept and the Retention Rate..... 13
Table 14. Estimated Catch per Unit of Effort (Fish/Hour). 14
Table 15. Estimated Summer Lake Trout Harvest by Anglers..... 15
Table 2.1. Estimated Catch per Unit of Effort (Fish/Hour) by Period. ... 19

List of Figures

Figure 1. Frances Lake, showing location of 2009 Angler Harvest Survey (*). 4
Figure 2. Lengths of lake trout caught by anglers, Frances Lake 2009. .. 9
Figure 3. Ages of lake trout caught by anglers, Frances Lake 2009. 9
Figure 2.1. Estimated Angler Effort (hour per day). 18
Figure 3.1. Per-hectare lake productivity of Yukon Lakes. Lakes near the left-hand side of the graph are the least productive. 20

Introduction

We conduct angler harvest surveys, also called creel surveys, on a number of Yukon recreational fisheries each year. We use these surveys, together with other fish and fishery-related assessments, to find out if the harvest of fish from the lake is sustainable. The Yukon Department of Environment tries to conduct angler harvest surveys on key fisheries either every 5 years or according to angler patterns and management concerns. The results of the surveys directly contribute to management decisions that make sure fisheries are sustainable over the long term.

Frances Lake (Tu cho, meaning 'big lake river', Coutts 2003) is located in southeast Yukon (about 100 km north of Watson Lake) in the Liard basin. Frances is the largest Yukon lake that does not flow into the Yukon River. Water from the lake drains into the Frances River, which flows into the Liard and then Mackenzie rivers and eventually reaching the Beaufort Sea. It is a large, deep lake with an area of 9,941 ha (99.41 km^2) and a mean depth of 31 m.

The lake is primarily accessed through the government campground at Km 171 of the Robert Campbell Highway. Frances Lake supports populations of lake trout, Arctic grayling, northern pike, lake whitefish, round whitefish, burbot, and is also one of the few lakes in the Yukon known to contain bull trout. The fishery on Frances Lake is primarily a lake trout fishery.

Frances Lake is within the Kaska traditional territory, home of the Liard First Nation and the Ross River Dena Council. Traditionally First Nations gathered at the narrows between the two arms of the lake to hunt, fish, and gather plants. Today they still camp on the western shore and hold elder gatherings and traditional fish camps (Peepre 2002).

Commercial and domestic fisheries have been carried out on Frances Lake since the early 1980s. Commercial fishing was officially closed on Frances Lake in 1992, and records indicate that the last commercial harvest occurred in 1989. A single domestic licence is held on Frances Lake, down from the peak of 4 licences in 1989.

We have conducted angler harvest surveys on 2 previous occasions: 1990 and 2000. In 2009 Frances Lake was chosen for surveying because of its level of use and importance to local First Nations and communities. The 2009 survey was done to:

- determine how much time anglers spent fishing (effort);
- understand the fishery's characteristics and patterns of use;
- measure the success rate of anglers;
- compare the level of harvest to the productive capacity of the lake;
- record biological information on harvested fish;
- provide anglers with information about regulations; and
- establish a fisheries management presence.

Harvest Regulations

Frances Lake has been managed as a Conservation Water (previously known as High Quality Water) since 1991. These regulations were put in place to maintain a high quality fishery on Frances Lake. Regulations protect a portion of the larger fish and encourage the harvest of smaller fish, while allowing the retention of a trophy fish if caught. Barbless hooks are required. The lake trout catch limit is 2 fish per day with 2 fish in possession. All lake trout between 65 cm and 100 cm must be released, and only one lake trout in possession may be larger than 100 cm. The Arctic grayling catch limit is 4 fish per day with 4 fish in possession. All grayling between 40 cm and 48 cm must be released, and only one grayling in possession may be larger than 48 cm. The northern pike catch limit is 4 fish per day with 4 fish in possession. All northern pike between 75 cm and 105 cm must be released, and only one northern pike in possession may be larger than 105 cm. General catch and possession limits apply to all other species.

The regulation history for Frances Lake is detailed in Appendix 1.

Methods

Survey

In 1990 the Yukon government adopted survey methodology developed by the Ontario Ministry of Natural Resources (Lester and Trippel 1985). A field worker conducts face-to-face interviews with anglers on selected sample days throughout the summer. The worker asks a standard set of questions about the social and biological aspects of the fishery. Data gathered include:

- How much time did anglers spend fishing?
- What fishing methods did anglers use?
- How did anglers fish (boat, shore, etc.)?
- Were anglers guided?
- Where were anglers from?
- What type of visitor were anglers (day users, campers, etc.)?
- What kinds of fish were anglers trying to catch?
- How many fish did anglers catch?
- How many fish did anglers release?

Any other information offered by anglers about their fishing experience is also recorded.

The field worker also collects biological data on the catch of cooperative anglers. Biological data gathered include: length (mm), mass (g), sex, maturity, an aging structure, as well as the collection of stomachs for content analysis in the lab. Any other information about general health and condition of the fish is recorded by the field worker (e.g., abnormalities, disease, lesions).

The field worker subjectively assesses the weather's effect on fishing over the entire sample day (no possible adverse effect, possible adverse effect, definite adverse effect).

The timing of the survey depends on management objectives, key species, and the nature of the fishery. It typically runs from ice out in the spring until either just after Labour Day or the end of September. The goal is to sample at least 20% of the total survey days. The survey is subdivided into several seasonal periods (usually 3 or 4) to better understand changes in angler activity. These periods are further divided into weekends and weekdays. Sample days are allocated to each period while considering both a higher weighting for those periods with the higher projected angler use and a minimum number of samples for each period.

Sample days are 14 hours long, 8:00AM to 10:00PM. On sample days, the field worker interviews all willing anglers. The field worker also records anglers who are observed but not interviewed.

Analysis

When the survey is finished, the data are entered into an Access database and analyzed using standard statistical methods. The age of sampled fish is determined by counting growth rings on the otolith (a small bone from the fish's head). Diet is determined by examining the stomach contents.

Lake Productivity

The productivity of a lake determines the amount of fish produced annually and can guide how much harvest can be sustained. Estimates of lake productivity are calculated using average lake depth, the concentration of total dissolved solids, and the average annual air temperature at the lake. Ryder's morphoedaphic index (1974) is used and incorporated into Schlesinger and Regier's equation (1982) for calculation of maximum sustained yield (MSY) for all species. Calculation of MSY for lake trout assumes a biomass of 30% lake trout; where appropriate this may be replaced by the most recent survey data. Following O'Connor (1982) and others, 15% of MSY provides an

"optimum" sustained yield (OSY), which maintains high quality fisheries on light to moderately fished lakes.

2009 Frances Lake Survey

The survey began on June 2 and concluded on September 9, 2009.

We used an access survey, meaning the field worker was stationed at the campground and boat launch at the west side of the lake (Figure 1) for the entire sample day and interviewed angling parties at the end of their fishing trip. Previous surveys and local knowledge suggest that most anglers access Frances Lake from this location. There is also a wilderness lodge on the lake. Our survey results did not capture this fishing activity but we did obtain harvest estimates from these anglers by communicating with the lodge owners.

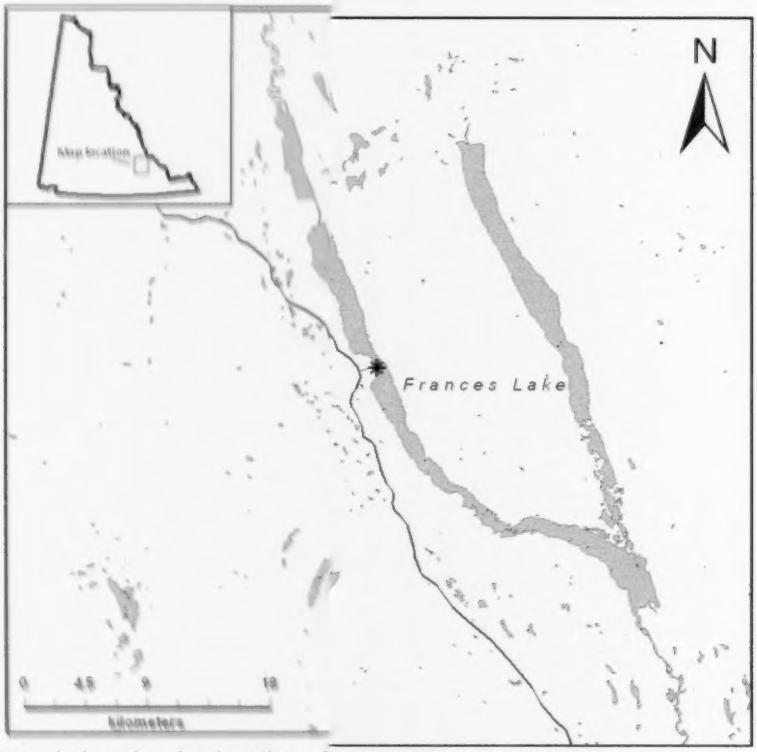

Figure 1. Frances Lake, showing location of 2009 Angler Harvest Survey (*).

The survey period was partitioned into 6 time periods, weekends and weekdays in June, July, and August/September. Of the 100 day survey period, 30 days were sampled for an overall sampling effort of 30%.

We analyzed the data in 2 ways. In the first, we combined data across all 6 time periods, and in the second part we compared results between time periods. We analyzed all data at the party level.

Results of the 2009 Survey

Effort

Anglers spent 1,592 hours fishing on Frances Lake over the 2009 survey period which is 0.16 hours per hectare, a below average level of effort for large Yukon lakes. There were 423 anglers in 247 parties. On average, there was 15.9 hours of angler effort per day over the entire survey, and each angler fished for 3.8 hours.

Fishing Methods

Trolling was the most popular method of fishing, followed by drift fishing and then combinations of methods (Table 1). Spin casting, fly casting, and jigging were all observed, but each in very small numbers.

Table 1. Fishing methods, Frances Lake 2009.

Method of Fishing	Percent of Parties
Still	
Jig	3%
Drift	35%
Troll	46%
Spin Cast	2%
Fly Cast	2%
Other or Combination	12%

Methods of Access

Most anglers accessed the lake by motorboat (Table 2). A few anglers accessed from shore and by canoe.

Table 2. Angler access methods, Frances Lake 2009.

Access Method	Percent of Parties
Canoe	3%
Rowboat	
Motorboat	91%
Shore	3%
Other	3%

Guided Anglers

No guided anglers were observed.

Angler Origin

Canadian anglers were the most frequent fishers, followed by local anglers (Watson Lake and Ross River; Table 3). Overall, Frances Lake anglers were more diverse than we typically see during our surveys.

Table 3. Angler origin, Frances Lake 2009.

Origin	Percent of Parties
Local	23%
Whitehorse	12%
Yukon	17%
Canada	35%
U.S.	5%
Other	3%
Unknown	5%

Visitor Type

All interviewed anglers stayed at the government campground. A few anglers stayed at the wilderness lodge but were not interviewed.

Weather

Weather had an adverse effect on fishing activity (Table 4).

Table 4. Sample day weather, Frances Lake 2009.

Did Weather Affect Angling?	Percent of Parties
No possible adverse effect	32%
Possible adverse effect	38%
Definite adverse effect	30%

Targeted Species

Anglers targeting a particular species were more successful than those that did not (Table 5). The majority of parties targeted lake trout and accounted for 97% of the catch and harvest. Only one group targeted northern pike, but didn't catch any. Most species appear to be incidental catches from the lake trout fishery.

Table 5. Catch and harvest by anglers targeting specific species, Frances Lake 2009.

Species	Percent of Parties	Percent of Total Catch	Percent of Total Harvest
Lake trout	87%	97%	97%
Northern pike	2%	0%	0%

Catch and Harvest

Lake trout were the most heavily caught and harvested species despite a low retention rate (Table 6). Low numbers of northern pike were caught. Incidental records of Arctic grayling, burbot, and bull trout were also observed in this survey, accounting for 2% of the total catch. Most species appear to be caught incidentally to the lake trout fishery.

Table 6. Angler catch and harvest, Frances Lake 2009.

Species	# Caught	# Kept	Retention Rate
Lake trout	499	110	22%
Northern pike	30	15	50%
Arctic grayling	2	0	0%
Burbot	4	4	100%
Bull trout	2	0	0%

Estimated angler success rates, calculated over the entire survey as the number of fish caught per hour of angling effort (CPUE), is presented for all anglers (regardless of target species) in Table 7. A lake trout CPUE of 0.31 is above average for Yukon lakes (mean 0.14 from 28 lakes).

Table 7. Estimated catch per unit of effort (fish/hour), Frances Lake 2009.

Species	CPUE
Lake trout	0.31
Northern pike	0.02
Arctic grayling	0.001
Bull trout	0.001
Burbot	0.003

Biological Data

We sampled 20 lake trout for fork length (mean 578 mm) and weight (mean 1,845 g). These fish had a mean condition factor of 0.95 which is average for lake trout in Yukon and indicates "fat" fish (condition factor is the relationship between length and weight). The sex ratio was 1.25 males per female. A similar number of lake trout were harvested across a wide range of size classes from 450 to 650 mm, the bottom of the slot limit (Figure 2).

We aged 16 of the sampled lake trout. These fish ranged from 7 to 24 years old (Figure 3), but the sample size is too small to make robust conclusions about the age distribution of lake trout in Frances Lake. Note that young fish (less than 5 years) are not vulnerable to angling gear and regulation does not allow harvest of larger fish (with the exception of one very large trophy). These portions of the population are therefore under represented in the sample.

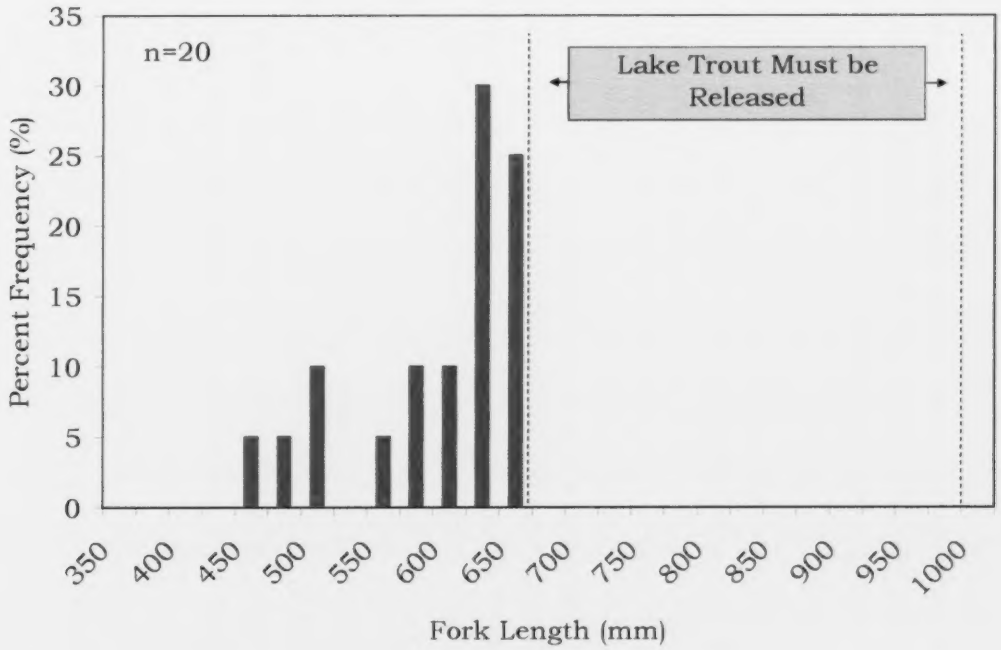

Figure 2. Lengths of lake trout harvested by anglers, Frances Lake 2009.

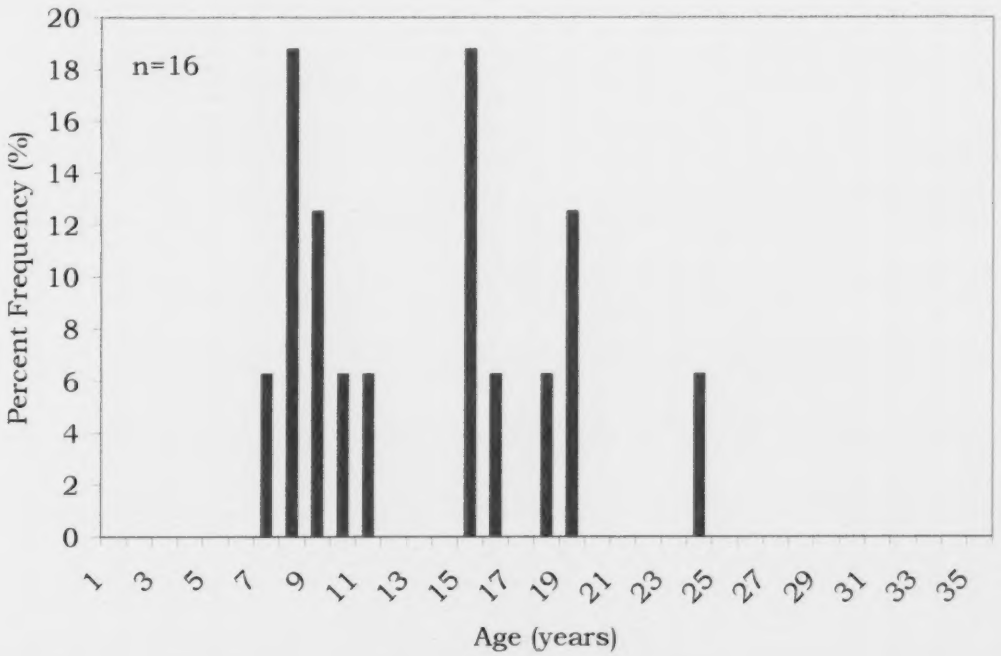

Figure 3. Ages of lake trout harvested by anglers, Frances Lake 2009.

We examined the stomachs of 16 lake trout. Of these, 9 were empty and the remaining 7 averaged 54% full. Unidentified fish were the most common diet item identified (Table 8).

Table 8. Sampled lake trout stomach contents, Frances Lake 2009.

Stomach Contents	Percent Volume
Fish (unidentified)	62%
Fish (round whitefish)	37%
Non-biting midges	1%

No other species were sampled for biological data over the survey.

Comparison With Previous Surveys

We previously surveyed the angler harvest on Frances Lake in 1990 and 2000. The 2000 survey was of similar methodology and design and is directly comparable with the 2009 survey. Only rough estimates were obtained in 1990, so comparisons should be made with caution.

Effort

Estimated summer open water angler effort over the past 19 years has fluctuated slightly (Table 9). We estimate 1,592 angler hours of effort over the 2009 survey. The 2009 estimate of angler effort is very similar to the first survey in 1990 but down about 25% from the 2000 survey.

Table 9. Total estimated angler hours, Frances Lake 2009 compared to 2000 and 1990.

	2009	2000	1990
Hours	1,592	2,051	1,517

Fishing Methods

Fishing methods have shifted slightly since the 2000 survey. Trolling and spin casting decreased in popularity while in 2009 drift fishing became the second most popular fishing method (Table 10). These data are not available from 1990.

Table 10. Fishing methods (percent of parties), Frances Lake 2009 and 2000.

Method	2009	2000	1990
Still			
Jig	3%		
Drift	35%		
Troll	46%	68%	N/A
Spin Cast	2%	15%	
Fly Cast	2%		
Other or Combination	12%	10%	

Methods of Access

Methods of access have only been recorded in the most recent surveys so no comparisons are possible.

Guided Anglers

No guided groups have ever been interviewed. There is a lodge on the lake, but these anglers are self-guided.

Angler Origin

Over the 19 years of survey data, the proportion of local anglers has decreased while there has been an increase in Yukon and Whitehorse anglers (Table 11). The percentage of Canadian anglers has remained consistent while the percentage of American anglers dropped since the previous survey. Note that Whitehorse and local anglers were combined as Yukon anglers in 1990.

Table 11. Origin of anglers (percent of parties), Frances Lake 2009 compared to 2000 and 1990.

Origin	2009	2000	1990
Local	23%	35%	N/A
Whitehorse	12%	7%	N/A
Yukon	17%	3%	59%
Canada	35%	35%	23%
U.S.	5%	20%	0%
Other	3%	1%	19%
Unknown	5%		

Visitor Type

Visitor type was recorded only in the most recent survey, when all angling parties were camped at the territorial campground.

Weather

The field worker's subjective assessment of weather effects on angling activity indicates that weather was similar in 2009 and 2000 so that the effect of weather can be discounted as the main reason why angler effort was lower (Table 12). Weather data were not recorded in 1990.

Table 12. Weather effects on angling activity (percent of parties), Frances Lake 2009 and 2000.

Did Weather Affect Angling?	2009	2000	1990
No possible adverse effect	32%	37%	
Possible adverse effect	38%	43%	N/A
Definite adverse effect	30%	20%	

Catch and Harvest

Lake trout catch estimates for 2009 were the highest to date (Table 13) but number of lake trout harvested only increased slightly as anglers released an increasing percentage of their catch.

Arctic grayling catches have declined over the surveys and retention has dropped to where no fish were kept in 2009.

Northern pike catches dropped in the 2009 survey after being consistent in the previous two surveys. Only one party in 2009 reported that they were targeting northern pike. Most northern pike catches were likely incidental catches while anglers were trolling for lake trout. Northern pike harvest levels have steadily dropped with each survey.

Burbot and bull trout catch was not reported in 1990 or 2000, and more recent estimates show that catches are incidental, with burbot being retained in 2009.

Estimated CPUE (number of fish per angler hour) over the entire survey can reflect changes in the fishery because it incorporates effort and catch. Dramatic decreases in CPUE for a particular species could indicate problems in terms of the health or status of the fish species in question. However, relying on CPUE of anglers alone is not recommended – see the section entitled "Invisible Collapse" in the *Status of Yukon Fisheries 2010* (Environment Yukon 2010) – anglers are very good at finding fish even when the population is in decline.

Table 13. Estimated number of fish caught, fish kept and the retention rate, Frances Lake 2009 compared to 2000 and 1990.

Species	Retention	2009	2000	1990
Lake trout	Caught	499	385	92
	Kept	110	97	50
	Released	389	288	42
	% Kept	22	25	54
Arctic grayling	Caught	2	14	121
	Kept	0	5	26
	Released	2	9	95
	% Kept	0	36	22
Northern pike	Caught	30	88	84
	Kept	15	21	33
	Released	15	67	51
	% Kept	50	24	39
Burbot	Caught	4		
	Kept	4		
	Released	0		
	% Kept	100		
Bull trout	Caught	2		
	Kept	0		
	Released	2		
	% Kept	0		

Lake trout CPUE increased between 1990 and 2009 (Table 14). The 2009 results were good and above the Yukon average for lakes surveyed to date. The CPUE data for species other that lake trout should be treated with caution. These species receive only a small amount of fishing effort, and so these estimates are quite rough.

Table 14. Estimated catch per unit of effort (fish/hour), Frances Lake 2009 compared to 2000 and 1990.

Species	2009	2000	1990
Lake trout	0.31	0.19	0.06
Northern pike	0.02	0.04	0.06
Arctic grayling	0.001	0.007	0.08
Bull trout	0.001		
Burbot	0.003		

Fishery Sustainability

The estimated productivity of Frances Lake is low, even for Yukon lakes (Figure 3.1, Appendix 3). We estimate that Frances Lake could sustain a total annual lake trout harvest of about 600 kg (total dissolved solids: 71 mg/L, mean annual air temperature: -4.0 °C, mean depth: 31.3 m; see Methods - *Lake Productivity*).

Anglers harvested 110 lake trout over the summer (Table 20). Total fish mortality (death) includes the unintentional mortality of any released fish. Catch and release, when done properly, has a minimal impact. Lake trout survival rates range from 93% for lightly handled fish to 76% for deep-hooked fish (YFWMB 1998). We used an average of 85% survival. For the 389 lake trout released this results in an additional mortality of 58 fish for a total of 168 fish. Based on the average size of harvested fish, the weight of total lake trout mortality in the recreational fishery was 311 kg.

Domestic licences have been issued on Frances Lake. Total annual lake trout harvest by domestic fishers has averaged 32 kg for the period spanning 1986 - 2008.

The Liard First Nation uses Frances Lake for subsistence fishing and although no data on the harvest have been collected it is believed to be quite small. Ice fishing also occurs on Frances Lake but harvest has never been formally monitored. Anecdotal information suggests that effort and harvest are minimal.

There is a wilderness lodge on Frances Lake and some guests fish occasionally, but none come to the lodge exclusively to fish. The lodge owner reports that harvest of fish by guests is 6–10 pike, 0–3 trout, and 6–15 grayling per year – a very low level and one that only marginally increases our harvest estimates. No information on retention rate was available from these anglers.

Our harvest estimate of 311 kg is therefore a minimum: it does not include harvests from the open water fishery outside of the period of this

survey, from the ice fishery, or the First Nations subsistence fishery. The 2009 harvest declined slightly from the harvest in 2000 (due to smaller fish being caught) but was much higher than the 1990 estimate (Table 15).

Table 15. Estimated summer lake trout harvest by anglers, Frances Lake 2009 compared to 2000 and 1990.

Lake Trout Harvested	2009	2000	1990
Lake trout harvested	110	97	50
Lake trout released	389	288	42
Catch and release mortality (15%)	58	43	6
Total harvest and mortality	168	140	56
Mean lake trout weight (kg)	1.85	2.54	1.15
Total harvest and mortality (kg)	311	356	64

A harvest of 311 kg is below the predicted sustainable yield of about 600 kg for Frances Lake. So long as the total unquantified harvest does not exceed 289 kg, then the current level of harvest should maintain a quality fishery. We recommend conducting angler harvest surveys as a regular part of monitoring this fishery. We also recommend that future surveys also assess in a qualitative, if not quantitative way, all additional harvests.

References

COUTTS, R. C. 2003. Yukon: Places & Names, 2nd Edition. Moose Creek Publishing, Whitehorse, Canada.

ENVIRONMENT YUKON. 2010. Status of Yukon Fisheries 2010: An overview of the state of Yukon fisheries and the health of fish stocks, with special reference to fisheries management programs. Fish and Wildlife Branch Report MR-10-01.

LESTER, N. P., AND E. A. TRIPPEL. 1985. CREESYS Users Manual. 2nd ed. Ontario Ministry of Natural Resources.

O'CONNOR, J. 1982. Unpublished data from Manitoba Government files. Department of Natural Resources, Winnipeg, Manitoba.

PEEPRE, J. 2002. Yukon Wild: Natural Regions of the Yukon, 2nd ed. Canadian Parks and Wilderness Society. Yukon, Canada.

RYDER, R. A., S. R. KERR, K. H. LOFTUS, AND H. A. REGIER. 1974. The morphoedaphic index. A fish yield estimator – Review and evaluation. *Journal of the Fisheries Research Board of Canada* 31(5): 663–668.

SCHLESINGER, D. A., AND H. A. REGIER. 1982. Climatic and morphoedaphic indices of fish yields from natural lakes. *Transactions of the American Fisheries Society* 111:141–150.

YUKON FISH AND WILDLIFE MANAGEMENT BOARD (YFWMB). 1998. An evaluation of hooking mortality resulting from live-release fishing practices. Whitehorse, Yukon.

APPENDIX 1. Frances Lake angling regulation changes 1989 to 2009.

Year	Species	Catch limit	Possession limit	Size restrictions
1989/90*		**General Regulations**		
	Lake trout	3	6	Only one fish over 80 cm
	Arctic grayling	5	10	none
	Northern pike	5	10	none
	Whitefish	5	10	none
1991/92		**Conservation Waters (formerly High Quality Waters)**		
	Lake trout	2	2	None between 65 and 100 cm; only one over 100 cm
	Arctic grayling	4	4	None between 40 and 48 cm; only one over 48 cm
	Northern pike	4	4	None between 75 and 105 cm; only one over 105 cm
2004/2005	*All conservation waters had maximum size limits this year (i.e., no lake trout > 65 cm, no Arctic grayling > 48 cm, and no northern pike > 105 cm), but slot limits were reinstated (as above) in 2005/2006*			

* Yukon Government obtained responsibility for freshwater fisheries management from the Federal Government in 1989.

APPENDIX 2. 2009 Results: Comparisons between periods

Effort

Mean daily angler effort was unusually slow in June. Effort picked up and was very high for both weekends and weekdays in July. There was a substantial drop, especially in weekend visitors, in August/September (Figure 2.1).

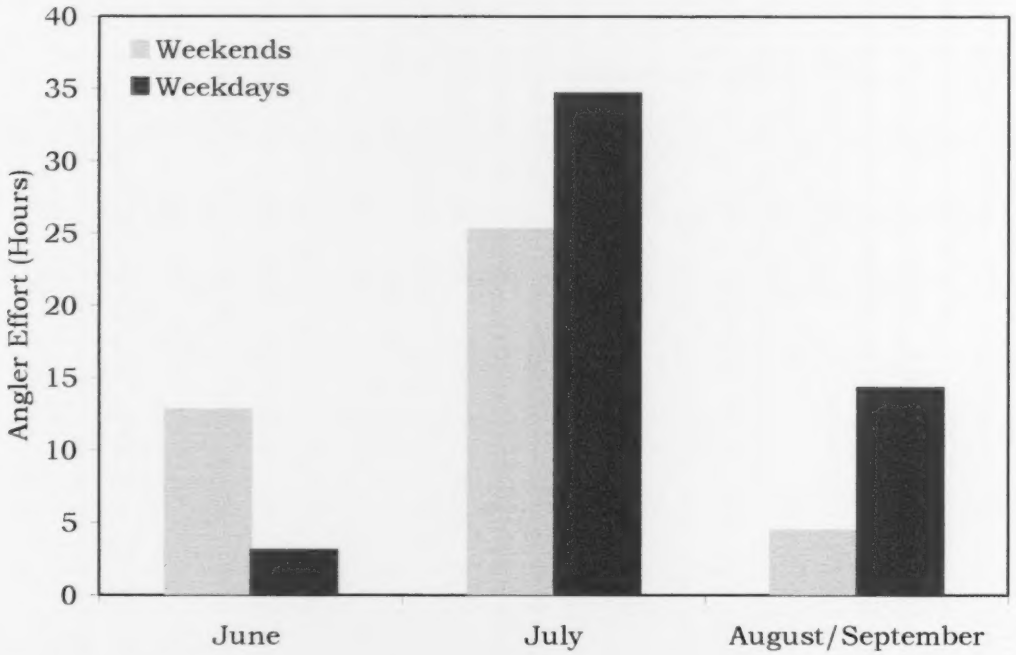

Figure 2.1. Estimated Angler Effort (hour per day).

Visitor Type

Territorial campground users were the only visitor type recorded throughout the entire survey period.

Catch

Lake trout CPUE was good over the summer; highest on weekdays in June and consistent on both weekends and weekdays in July. Lake trout CPUE was lowest on weekends in August/September (Table 2.1). Northern pike CPUE was low in most periods, but higher on June weekdays. Arctic grayling, burbot, and bull trout were only incidentally

or infrequently angled for in a couple of periods with very low CPUE (Table 2.1).

Catch per unit effort patterns for lake trout are consistent with typical Yukon summer patterns. Success is high in the spring following ice out and then drops as water temperature warms. Fall increases are usually related to onset of spawning and cooling water temperatures. These fluctuations are not dramatic on Frances Lake as CPUE remained fairly consistent over the summer.

Table 2.1. Estimated Catch per Unit of Effort (Fish/Hour) by Period.

Period	Lake Trout	Northern Pike	Bull Trout	Arctic Grayling	Burbot
June weekends	0.10	0.02		0.02	
June weekdays	0.63	0.21			
July weekends	0.30	0.03	0.009		
July weekdays	0.30	0.009			
August/September weekends	0.05				
August/September weekdays	0.40	0.01			0.01

APPENDIX 3. Productivity of Frances Lake relative to other Yukon Lakes.

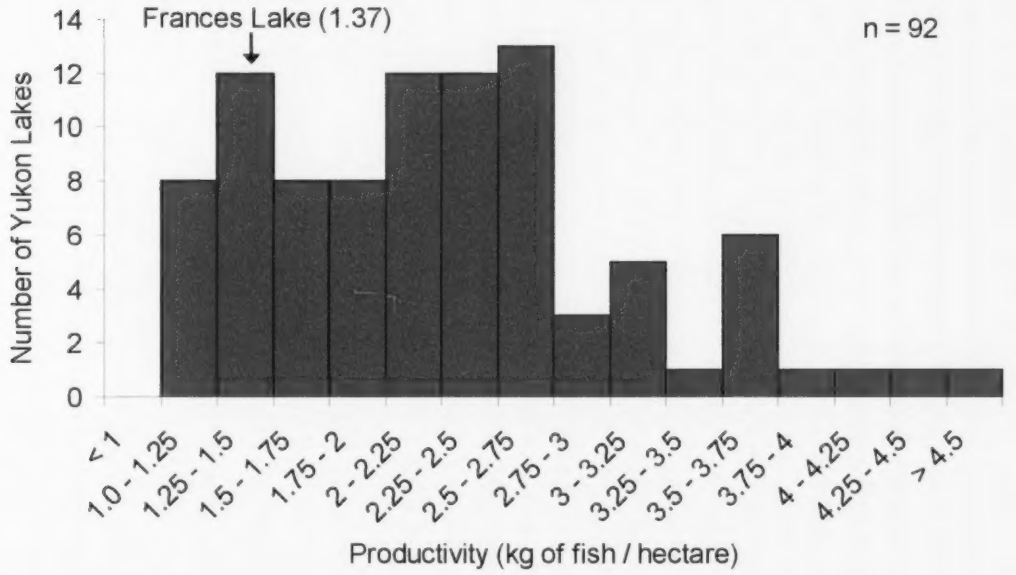

Figure 3.1. Per-hectare lake productivity of Yukon Lakes. Lakes near the left-hand side of the graph are the least productive.